

ABSTRACT

**TRENCH-GATE SEMICONDUCTOR DEVICES**

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A trench-gate semiconductor device, for example a MOSFET or an IGBT, has a network of connected trenches (20) containing gate material (21) in a semiconductor body (10) in an active transistor cell area 100 with an n-type source region (13A) and an underlying channel accommodating p-type region (15A) in each cell. A source electrode (51) contacts the source regions (13A). Trenches (20) containing gate material (21) extend from the network of connected trenches in the area 100 to an inactive area (200) having a gate electrode contact area (201) where a gate electrode (53) contacts the gate material (21) on the whole area of the trenches (20) adjacent the semiconductor body surface (10a) and where the gate electrode (53) also contacts the semiconductor body surface (10a) adjacent the trenches (20). The semiconductor body surface (10a) contacted by the gate electrode (53) has n-type surface regions (13B) and underlying p-type regions (15B) to provide a voltage establishing diode between the gate electrode (53) and a drain electrode (52) of the device. In a modified device (Figures 6 and 7) at least some of otherwise isolated cells in the inactive area are instead linking cells (60) across the inactive and active areas. The linking cells, by means of continuous underlying p-type regions (15B, 15A) provide voltage protection diodes between the gate electrode (53) and the source electrode (51).

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(Figure 4)